LIGHT OF THE SOLAR ORB.

How It Is Generated and How It is Dispensed.

GLORIOUS SOLAR MANTLE

CARBON THE PROBABLE CHEMICAL SOURCE OF THE SUN'S LIGHT.

The Same Material So Familiar to All in Incandescent and Arc Electric Lamps--A Most Abundant Material.

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The light of the great orb of day emanates solely from a closely fitting robe of surpassing brightness. The great bulk of the sun which lies within that brilliant mantle is comparatively obscure, and might at first seem to play but an unimportant part so far as the dispensing of light and heat is concerned. It may indeed be likened to the coal cellar from whence are drawn the supplies that produce the warmth and brightness of the domestic hearth; while the brilliant robe where the sun develops its heat corresponds to the grate in which the coal is consumed. With regard to the thickness of the robe we might liken this brilliant exterior to the rind of an orange, where the gloomy interior regions would correspond to the edible portion of the fruit. Generally speaking the rind of the orange is rather too coarse for the purpose of this illustration. It might be nearer the truth to affirm that the luminous part of the sun may be compared to the delicate slimy skin of the peach. There can be no doubt that if this glorious veil were unhappily stripped from the sun the great luminary would forthwith lose its powers of shedding forth light and heat. The spots which we see so frequently to fleck the dazzling surface, are merely rents in the brilliant mantel through which we are permitted to obtain glimpses of the comparatively nonluminous interior.

Composition of the Solar Clouds.

As the ability of the sun to warm and light this earth arises from the peculiar properties of the thin growing shell which surrounds it, a problem of the greatest interest is presented in an inquiry as to the material composition of this particular layer of solar substance. We want, in fact, to ascertain what that special stuff can be, which enables the sun to be so useful to us dwellers on the earth. This great problem has been solved and the result is extremely interesting and instructive; it has been discovered that the material which confers on the sun its beneficent power, is also a material which is found in the greatest abundance on the earth, where it fulfills purposes of the very highest importance. Let us see in the first place what is the most patent fact with regard to the structure of this solar mantle possessed of a glory so indescribable. It is perfectly plain that it is not composed of any continuous solid material. It has a granular character which is sometimes perceptible when viewed through a powerful telescope, but which can be seen more frequently, and studied more satisfactorily, on a photographic plate. These granules have an obvious resemblance to clouds, and clouds indeed, we may call them. There is, however, a very wide difference between the solar clouds and those clouds which float in our own atmosphere. The clouds which we know so well, are of course merely vast collections of globules of water suspended in the air. No doubt the mighty solar clouds do also consist of incalculable myriads of globules of some particular substance floating in the solar atmosphere. The material of which these solar clouds are composed is, however, I need hardly say, not water; nor is it anything in the remotest degree resembling water. Some years ago any attempt to ascertain the particular substance out of which the solar clouds were formed, would at once have been regarded as futile, inasmuch as such a problem would then have been thought to lie outside the possibilities of human knowledge. The advance of discovery has, however, shed a flood of light on the subject and has revealed the nature of that material to whose presence we are indebted for the solar beneficence. The detection of the particular element to which all living creatures are so much indebted, is due to that distinguished physicist, Dr. G. Johnstone Stoney.

The Sun Stars and Earth All Made of the Same Material.

In the whole range of science, one of the most remarkable discoveries ever made is that which has taught us that the elementary bodies of which the sun and the stars are constructed are essentially the same as those of which the earth has been built. This discovery was indeed as unexpected as it is interesting. Could we ever have anticipated that a body ninety-three millions of miles away, as the sun is, or a hundred million of millions of miles distant, as a star may be, should actually prove to have been formed from the same materials as those which compose this earth of ours and all which it contains, whether animal or inanimate? Yet such is indeed the fact. We are thus, in a measure, prepared to find that the material which forms the great solar clouds, may turn out to be a substance not quite unknown to the terrestrial chemist, nay, further, its very abundance in the sun might seem to suggest that this particular material might perhaps prove to be one which was very abundant on the earth.

Carbon.

I had occasion to make use of the word carbon in a lecture which I gave a short time ago, and I thought when I did so, that I was of course merely using a term with whose meaning all my audience must be well acquainted. But I found out afterwards that in this matter I had been mistaken. I was told that my introduction of the word carbon had quite puzzled some of those who were listening to me. I learned that a few of those who were unfamiliar with this word, went to a gentleman of their acquaintance who they thought would be likely to know, and begged from him an explanation of this mysterious term; whereupon he told them that he was not quite sure himself, but believed that carbon was something which was made out of nitro-glycerine! Even at the risk of telling what every school boy ought to know, I will say that carbon is one of the commonest as well as one of the most remarkable substances in nature. A lump of coal only differs from a piece of carbon by the ash which the coke leaves behind when burned. As charcoal is almost entirely carbon, so wood is largely composed of this same element. Carbon is indeed present everywhere. In various forms carbon is in the earth beneath our feet and in the air which we breathe. The substance courses with the blood through our veins; it is by carbon that the heat of the body is sustained; and the same element is intimately associated with life in every phase. Nor is the presence of carbon merely confined to this earth. We know it abounds on other bodies in space. It has been shown to be eminently characteristic of the composition of comets. Carbon is not only intimately associated with articles of daily utility, and of plenteous abundance, but with the most exquisite gems of "purest ray serene." More precious than gold, more precious than rubies, the diamond itself is no more than the same element in crystalline form. But the greatest of all the functions of carbon in the universe has yet to be mentioned. This so the sun in heaven uses precisely the same element as the immediate agent in the production of its transcendent light and heat. Owing to the extraordinary fervour which prevails in the interior parts of the sun, all substances there present, no matter how difficult we may find their fusion, would have to submit to be melted, nay, even to be driven off into vapor. If submitted to the heat of this appalling solar furnace, an iron poker, for instance, would vanish into invisible vapor. In the presence of the intense heat of the inner parts of the sun, even carbon itself is unable to remain solid. It would seem that it must assume a gaseous form under such circumstances, just as the copper and the iron and all the other substances do which yield more readily than it to the fierce heat of their surroundings.

Carbon Vapor in the Sun's Atmosphere.

The bouyancy of carbon vapour is one of its most remarkable characteristics, accordingly immense volumes of the carbon-steam in the sun, soar at a higher level than do the vapours of the other elements. Thus carbon becomes a very large and important constituent of the more elevated regions of the solar atmosphere. We can understand what happens to these carbon vapours by the analogous case of the familiar clouds in our own skies. It is true, no doubt, that our terrestrial clouds are composed of a material totally different from that which constitutes the solar clouds. The sun evaporates the water from the great oceans which cover so large a portion of our earth. The vapor thus produced ascends in the form of invisible gas through our atmosphere, until it reaches an altitude, thousands of feet above the surface of the earth. The chill that the watery vapor experiences up there is so great that the vapor collects into little liquid beads, and it is, of course, these liquid beads, associated in countless myriads, which form the clouds we know so well.

We can now understand what happens as the bouyant carbon vapor soar upwards through the sun's atmosphere. They attain at last to an elevation where the fearful intensity of the solar heat has so far abated that, though nearly all other elements may still remain entirely gaseous, yet the exceptionally refractory carbon begins to return to the liquid state. At the first stage in this return, the carbon vapor conducts itself just as does the ascending watery vapor from the earth, when about to be transformed into a visible cloud. Under the influence of a chill the carbon vapor collects into a myriad host of little beads of liquid. Each of these drops of liquid carbon in the glorious solar clouds, has a temperature and a corresponding radiance, vastly exceeding that with which the filament glows in the incandescent electric lamp. When we remember further that the entire surface of our luminary is coated with these clouds, every particle of which is thus intensely luminous, we need no longer wonder at that dazzling brilliance which, even across the awful gulf of ninety-three million of miles, produces for us the indescribable glory of daylight.

The Carbon Wire in the Electric Lamp.

In the ordinary incandescent electric lamp, the brilliant light is produced by a glowing filament of carbon. The powerful current of electricity experiences so much resistance as it flows through this badly conducting substance, that it raises the temperature of the carbon wire so as to make it dazzling white-hot. Indeed the carbon is thus elevated to a temperature far in excess of that which could be obtained in any other way. The reason why carbon is employed in the electric lamp, in preference to any other substance, may be easily understood. Suppose we try to employ an iron wire as the glowing filament within the well known glass globe. Then when the current was turned on, that iron would of course become red hot and white hot, but ere a sufficient temperature had been attained so as to produce the requisite illumination, the iron wire would have been fused into drops of liquid, the current would have been broken, and the lamp would have been destroyed. Nor would the attempt to make an incandescent lamp have proved much more successful, had the filament been made of any other metal. The least fusible of metals is the costly element platinum, but even a wire of platinum, though it would stand much more heat than a wire of iron, or steel, would have not retained the solid form by the time it had been raised to the temperature necessary for an incandescent lamp.

The Sun's Light a Mass of Heated Carbon.

There is no known metal, and perhaps no substance whatever, which demands so high a temperature to fuse it as does the element carbon. A filament of carbon and a filament of carbon alone, will remain unfused and unbroken, when heated by the electric current to the dazzling brilliance necessary for effective illumination. This is the reason why this particular element is so indispensable for our incandescent electric lamps. Modern research has now taught us, that just as the electrician has to employ carbon as the immediate agent in producing the brightest of artificial lights down here, so the sun in heaven uses precisely the same element as the immediate agent in the production of its transcendent light and heat. Owing to the extraordinary fervour which prevails in the interior parts of the sun, all substances there present, no matter how difficult we may find their fusion, would have to submit to be melted, nay, even to be driven off into vapor. If submitted to the heat of this appalling solar furnace, an iron poker, for instance, would vanish into invisible vapor. In the presence of the intense heat of the inner parts of the sun, even carbon itself is unable to remain solid. It would seem that it must assume a gaseous form under such circumstances, just as the copper and the iron and all the other substances do which yield more readily than it to the fierce heat of their surroundings.

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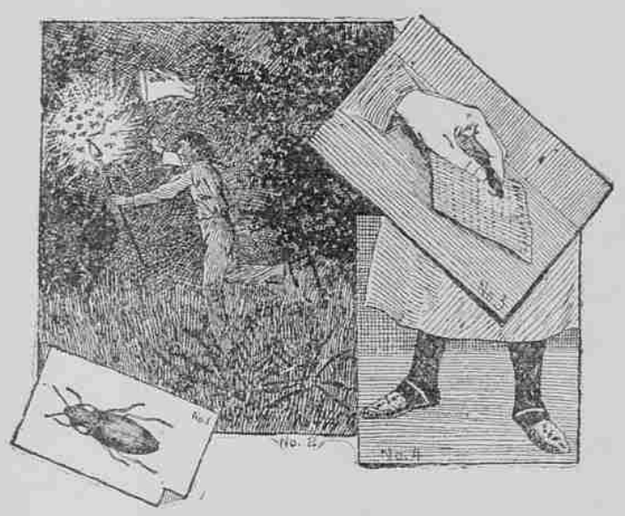
DUCHESS OF YORK.



No. 1—Luminous Beetle Pyrophorus Noctilucus.
No. 2—Indian Catching Luminous Beetles.
No. 3—Reading By the Light of Phosphorescent Beetle.
No. 4—Luminous Beetles Attached to the Shoe or Feet.

AN OCTOBER DESIGN.

HINTS ON PLANTING.

Select thrifty young trees, rather than old or very large ones; the former bear transplating better, can be more easily trained to any desired shape, and eventually become more valuable.

For small grounds or street planting where it is necessary to make a show as soon as possible, large trees are often desirable, and when handled with care should not fail to do well; but with the general planter the average loss will be much less, and both time and money will be saved if young trees are selected to commence with.

LIVING SIGNALS.

CURIOUS LIGHT-GIVING BEETLES OF THE TROPICS.

It Is Impossible to Annihilate the Phosphorescence of This Insect, That Hunts and Moves by the Glow of Its Own Brilliant Lanterns.

BY C. F. HOLDER.

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While A Dane and a gentleman who had struck a match to light his cigar received a blow upon the head from a beetle that dropped to the ground. When captured the insect appeared to eye him for a moment through two great orbs that emitted gleams of yellow light.

Interesting Experiments.

The beetle was one of the light-givers, common in the tropics—the lantern beetle, or pyrophorus—and that it had been attracted by the light of the match was so apparent that it occurred to an observer to try some experiments, which resulted in suggesting that the two bright phosphorescent spots in the prothorax of the beetle were veritable signals used as a means of communication.

One experiment was to catch several beetles and hold them, one by one, at an open window on a very dark night. The lights were so brilliant that they could be seen for a long distance; and that the other beetles recognized the gleam was very evident, as in a short time a beetle dashed in at the open window, others alighted on the hand of the experimenter, where they crawled about in apparent curiosity, which would seem to prove that the lights were to some extent a signal language.

Beetle Hunting.

In Vera Cruz the beetles are used by some natives as ornaments and the occupation of catching them is a peculiar one, still further illustrating the fact that the lights are signals. There being a demand for the living beetles the native Indians are constantly on the watch for them.

On dark moonless nights they sally forth into the deep woods or the borders of swamps where the beetles congregate in large numbers. Here they light pieces of peculiar wood which has the faculty of burning like a coal for a long time and fasten one or two upon the end of a long stick. Waving this in the air they soon attract the light-givers that evidently think the light is the phosphorescent signal light of a fellow beetle. While they are dashing about the natives lower the burning wood to a convenient distance and then catch them in a net. From this they are taken and placed in a box with wire covering, bathed two or three times in a day and fed at night on sugar cane. This method of treatment enables the natives to keep them for some time or until some banquet, ball or garden fete when they are sold in large numbers for decoration. Upon one occasion at a ball masque the gown of one of the masquers was covered with hundreds of these beetles carefully attached to a wire, which flashed in the night like myriads of living lamps.

Aiding a Scientist.

These singular lights have often been of benefit to man. The naturalist Jaeger said that he felt particularly grateful to the beetles in San Domingo, where they were frequently the means of saving his life. Often he would have missed his way had not these living signals lighted the forest so that he could find the path. Jaeger also employed a number to read by, collecting them in a glass.

The natives of Central America in early days were in the habit of using the beetles to light their way through the forest. In fact, the beetle seems to have been nature's electric light. Oviedo states that the natives not only used them to illuminate the dark portions of the forest but employed them to spin, weave, paint and dance by. The vast numbers of these luminous beetles more than once alarmed the little army of Cortez. The latter, seeing the myriads of lights suddenly springing into existence out of the darkness and apparently marauding on them, called his men to arms only to find the lights proceeded from the large beetle cucujo.

Testing the Light.

That the light is more or less dependent upon the will of the insect has been shown. Some interesting experiments are possible with this little creature. The light which in the spots is green, in the eggs of the beetle appear blue. The eggs are remarkable for their luminosity, and even when dried retain their light for a while, the latter appearing when the eggs are moistened. The luminous organs of the beetle have been ground in a mortar, dried in a vacuum and when placed in boiling water became luminous at once.

That the lights of the beetles are not only signals but lanterns for the insect itself is seen by covering one of the phosphorescent spots with wax, thus depriving it of one light, the beetle will move in a curve. Now cover the other spot and the beetle will move in an uncertain way, feeling carefully with its antennae.

With the light of one of these beetles (pyrophorus) photographs have been taken, and a beetle has been successfully photographed by its own light.

As to the cause of this wonderful exhibition, which is essentially a living light, little is known. Many explanations have been given, but none thoroughly satisfactory; so here is a mystery of nature that still remains unsolved.